Stillwater Ecosystem, Watershed & Riverine Sciences
2532 Durant Avenue Suite 201
Berkeley, CA 94704
Phone (510) 848-8098 Fax (510) 848-8398

M E M O R A N D U M

DATE: July 3, 2000

TO: Scott Spaulding and Craig Fleming USFWS–AFRP

FROM: Jennifer Vick, Stillwater Sciences

SUBJECT: Revised Preliminary Analysis of Data From 1999 Stanislaus River Rotary Screw Trap Experiments

This report has been revised to include additional recaputure information provided by S.P. Cramer and Associates following completion of the original report, dated March 17, 2000.

Background

Flows in the lower Stanislaus River are controlled by the New Melones Project. Under the authority of the Central Valley Improvement Act (CVPIA), the Bureau of Reclamation and the U.S. Fish and Wildlife Service are developing operating criteria for the New Melones Project to maximize production of fish resources in the lower Stanislaus River. With this in mind, the 1999 Annual Work Plan for the Stanislaus River Basin Water Needs, CVPIA Section 3406(c)(2), identified general objectives and actions to provide information useful to the overall planning efforts for the operation of the New Melones Project. A key objective in this plan was to evaluate elements of biological water needs and flow effects, including relationship of flow volume and patterns to biological processes.

In 1999, the U.S. Fish and Wildlife Service conducted releases of marked chinook salmon smolts to assess smolt survival in the Stanislaus River. Stillwater Sciences worked with the U.S. Fish and Wildlife Service to design the releases so that a multinomial mark-recapture model could be used to estimate survival in specific reaches of the river. Field implementation of the studies was conducted by S.P. Cramer and Associates. Marked salmon were captured in rotary screw traps at two locations – Oakdale (RM 40) and Caswell (RM 8). Salmon were released at five locations – Knights Ferry (RM 56.7), immediately upstream of the Oakdale trap (RM 40), immediately upstream of the Oakdale Recreational Area (RM 40), immediately downstream of the Oakdale Recreational Area (RM 38), and immediately upstream of the Caswell trap (RM 8) (Figure 1). All marked fish captured in the traps were re-marked and re-released. Release and recovery data are shown in Table 1.

Stillwater Sciences developed a simple mark-recapture model to estimate survival in specific river reaches and in all reaches combined based on the releases described above. Typically, survival has been estimated by expanding the number of recaptured fish based on estimated trap efficiency. In this approach, trap efficiency is estimated by releasing marked fish immediately upstream of the trap, and efficiency is defined as the ratio of fish recaptured to fish released. This approach is vulnerable to problems of estimating trap efficiency, which may result in significant over- or under-estimation of survival. This was demonstrated on the Tuolumne River, where releases of marked fish immediately upstream of a rotary screw trap consistently and significantly underestimated trap efficiency (TID/MID 1998, 1999). The multinomial model does not rely on traditional estimates of trap efficiency but rather analyzes the data as an interlocking set of paired releases.

This study consisted of five smolt release groups totaling approximately 50,000 coded-wire tagged (CWT) fish (Figure 1). One group of approximately 25,000 CWT fish was released at Knights Ferry (RM 54.7); the second group of approximately 800 CWT fish (split into two sub-groups) was released upstream of the Oakdale rotary screw trap (RM 40); the third group of approximately 10,000 CWT fish (split into two sub-groups) was released just upstream of the Oakdale Recreation ponds; a fourth group of approximately 10,000 CWT fish (split into two subgroups) was released below the Oakdale Recreation ponds at about RM 39; and the final group of 5,000 CWT fish (also split into two separate groups) was released around RM 8 upstream of the Caswell rotary screw trapping (RST) site, which served as the efficiency release for the Caswell traps. The existing RST sites, one trap at RM 40 near Oakdale and two traps near Caswell State Park (RM 8), served as the primary recovery locations for the marked fish. All release groups bore unique marks, and any fish captured in the Oakdale rotary screw trap was given a new mark and re-released. The numbers of fish released and marks used are shown in Table 1. All fish released for this study were coded-wire tagged and adipose fin-clipped. Two CWT lots were used (one for the Knights Ferry release and one for the downstream release groups). The fish groups released at the lower four sites (constituting one tag lot) also had a secondary dye inoculation mark so that their release location could be identified without sacrificing the fish, which is necessary for recovering the CWT.

The fish were released over a three day period during flows of 1,230–1,370 cfs (Figure 1, Table 1). The first day included the release of 25,000 fish at Knights Ferry, 400 fish upstream of the Oakdale rotary screw trap, and one group each of 5,000 fish above Oakdale Recreation Area and below Oakdale Recreation Area, respectively. The second day included the release of the remaining 400 fish upstream of the Oakdale rotary screw trap and the remaining 5,000 fish groups at the two Oakdale sites downstream of the trap and 2,500 fish at the Caswell site. On the final day, the remaining group of 2,500 fish was released at the Caswell site. This release strategy was intended to allow the fish to disperse in as natural a pattern as possible and to maximize the likelihood that the fish would move through the same segments of river under the same environmental conditions.

Table 1. Fish release groups used for 1999 smolt survey evaluations and recaptures at the Oakdale and Caswell Traps.

Release Location	Release Date	Mark[1]	Number Released	Mean Length (mm)	# Recaptured at Oakdale	% Recaptured at Oakdale	# Recaptured at Caswell	% Recaptured at Caswell
Knights Ferry	1 June	Ad-clip	25,536	ND	156	0.6	35	0.1
Oakdale Eff.	1 June	BCG + Ad-clip	367	82.9	1	0.3	0	0.0
Oakdale Eff.	2 June	AFG + Ad-clip	394	86.3	5	1.3	0	0.0
RM 40	1 June	DFK + Ad-clip	4,975	84.4	N/A	N/A	10	0.2
RM 40	2 June	TCK + Ad-clip	4,403	83.2	N/A	N/A	7	0.2
RM 38	1 June	BCK + Ad-clip	4,981	85.3	N/A	N/A	8	0.2
RM 38	2 June	AFK + Ad-clip	5,007	84.8	N/A	N/A	8	0.2
Caswell Eff.	2 June	DFG + Ad-clip	2,500	83.6	N/A	N/A	63	2.5
Caswell Eff.	3 June	TCG + Ad-clip	2,487	84.2	N/A	N/A	39	1.6
Oakdale re-mark	3–6 June	DFP	146	ND	N/A	N/A	0	0.0

[1] Mark Abbreviations:

Fin	Color
TC– top caudal	K– black
BC– bottom caudal	G– green
AF– anal	
DF– dorsal	

Analysis Methods

The tasks, as defined in the scope of work are as follows:

Task 1: Estimate survival (with confidence intervals) in the upper and middle reaches (Knights Ferry–RM 40 and RM 40–RM 38, respectively) using a multinomial model. This model treats the Knights Ferry, RM 40, and RM 38 releases as an interlocking set of three paired-release experiments with recoveries at the Caswell trap. The model does not rely on estimated trap efficiency at Caswell.

Task 2a: Estimate survival (with confidence intervals) in all three reaches (Knights Ferry–RM 40, RM

40–RM 38, and RM 38–Caswell) and river-wide using the traditional approach, which expands recovery based on estimated trap efficiency. This task relies on recaptures at Caswell and estimated daily trap efficiency (based on the efficiency relationships developed by S.P. Cramer and Associates). For reaches Knights Ferry–RM 40 and RM 40–RM 38, compare the results of the more traditional estimates to the results of the multinomial modeling completed in Task 1.

<u>Task 2b</u>: Estimate survival (with confidence intervals) between Knights Ferry–RM 40 using Oakdale recovery data and the Oakdale efficiency experiment (conducted during the survival releases). Compare this with the reach Knights Ferry–RM 40 survival estimate from Tasks 1 and 2a.

The methods used to complete these analyses are described in Appendix A.

Results

Results of the survival analyses are shown in Table 2 and Figures 2, 3 and 4.

Table 2. Estimated smolt survival in the Stanislaus River, 1999.

Reach	**Estimated Survival and 95 % confidence intervals (%)**		
	Multinomial Model (Task 1)	**Traditional based on Caswell recoveries (Task 2a)**	**Traditional based on Oakdale recoveries (Task 2b)**
Knights Ferry–RM 40	80 (51–100)	77 (44–100)	77 (40–100)
RM 40–RM 38	100 (57–100)	100 (55–100)	
RM 38–Caswell	8.2 (6.3–13)[1]	7.8 (4.2–12)[1]	
River-wide	6.6 (4.5–8.5)[1]	6.7 (4.4–9.6)[1]	

[1] These estimates rely on traditional estimates of trap efficiency at Caswell. The estimate used is 2.1%.

The benefits of the multinomial approach are limited because only two recovery locations (i.e., trap locations) were available in the design. As such, the multinomial model (Task 1) and the traditional method using Caswell recoveries (Task 2a) use exactly the same data and the same assumptions about survival and recovery of each group individually. (Superficially, the traditional method for estimating survival in the Knights Ferry–RM 40 and the RM 40–RM 38 reaches uses an efficiency estimate at the Caswell trap, but this term cancels out algebraically, contributing nothing to the final estimator). The only differences between the two approaches are that the multinomial model is constrained by the requirement that all survival parameters in the model must be #100%, and that the multinomial model is able to form slightly smaller confidence intervals because it treats all three releases as a single experiment, rather than three separate experiments. Neither method provides any check on the validity of the efficiency assumption at the Caswell trap.

The multinomial model and the traditional method using Oakdale recoveries (Task 2b) use different data sets and different assumptions. In particular, the former makes no assumption about efficiency at either trap, whereas the latter depends on an efficiency-release for the Oakdale trap. In this reach, the general agreement of the estimates indicates that, at least for this particular experiment, the assumptions of the trap efficiency releases were met. It is not known whether this would be the case under other flow conditions or for other releases.

APPENDIX A. DESCRIPTION OF MODELS USED FOR SURVIVAL ANALYSIS

TASK 1. MULTINOMIAL MODEL

Assumptions:

- All smolts released at Knights Ferry have the same probability n_1 of surviving to RM 40.
- All smolts released at RM 40, and all smolts from Knights Ferry reaching RM 40, have the same probability n_2 of surviving to RM 38.
- All smolts released at RM 38, and all smolts from Knights Ferry or RM 40 reaching RM 38, have the same probability ó of appearing in the Caswell traps.

Let $\mathbf{n} = (\mathrm{n}_1, \mathrm{n}_2, \text{ó})$.

Under these assumptions, the probability of recovering $\boldsymbol{m} = \{m_1, m_2, m_3\}$ smolts from the Knights Ferry, RM 40, and RM 38 releases, respectively, out of releases of $\boldsymbol{n} = \{n_1, n_2, n_3\}$ smolts at these locations, is

$$\begin{aligned} p(\boldsymbol{m}|\mathbf{n},\boldsymbol{n}) &= \binom{n_1}{m_1} (\mathrm{n}_1\mathrm{n}_2\text{ó})^{m_1}(1-\mathrm{n}_1\mathrm{n}_2\text{ó})^{n_1-m_1} \\ &\times \binom{n_2}{m_2} (\mathrm{n}_2\text{ó})^{m_2}(1-\mathrm{n}_2\text{ó})^{n_2-m_2} \\ &\times \binom{n_3}{m_3} \text{ó}^{m_3}(1-\text{ó})^{n_3-m_3} \end{aligned}$$

The likelihood, $L(\mathbf{n}|\boldsymbol{m},\boldsymbol{n})$, is any function proportional to this, considered as a function of $\mathbf{n}$.

Temporarily ignoring the requirement that $\mathbf{n} \in [0,1]^3$, the maximum value of L is easily found to occur at

(2a) $$\hat{\mathrm{n}}_1 = \frac{m_1}{n_1} / \frac{m_2}{n_2}, \quad \hat{\mathrm{n}}_2 = \frac{m_2}{n_2} / \frac{m_3}{n_3}, \quad \hat{\text{ó}} = \frac{m_3}{n_3}.$$

This will be the maximum likelihood estimate when it is in the parameter space.

If the point (2a) does *not* lie in the parameter space, the maximum likelihood is attained somewhere on the boundary, and the estimator should be modified accordingly. The following cases can arise:

- If $\frac{m_1}{n_1} > \frac{m_2}{n_2}$ and $\frac{m_1+m_2}{n_1+n_2} \leq \frac{m_3}{n_3}$, the estimator is

(2b) $$\hat{\mathrm{n}}_1 = 1, \quad \hat{\mathrm{n}}_2 = \frac{m_1+m_2}{n_1+n_2} / \frac{m_3}{n_3}, \quad \hat{\text{ó}} = \frac{m_3}{n_3}.$$

• If $\frac{m_2}{n_2} > \frac{m_3}{n_3}$ and $\frac{m_1}{n_1} \le \frac{m_2+m_3}{n_2+n_3}$, the estimator is

$$\hat{n}_1 = \frac{m_1}{n_1} \Big/ \frac{m_2+m_3}{n_2+n_3}, \quad \hat{n}_2 = 1, \quad \hat{o} = \frac{m_2+m_3}{n_2+n_3}. \tag{2c}$$

• Finally, if $\frac{m_1}{n_1} > \frac{m_2}{n_2}$ and $\frac{m_1+m_2}{n_1+n_2} > \frac{m_3}{n_3}$, or if $\frac{m_2}{n_2} > \frac{m_3}{n_3}$ and $\frac{m_1}{n_1} > \frac{m_2+m_3}{n_2+n_3}$, the estimator is

$$\hat{n}_1 = 1, \quad \hat{n}_2 = 1, \quad \hat{o} = \frac{m_1+m_2+m_3}{n_1+n_2+n_3}. \tag{2d}$$

For the Stanislaus River data, $\boldsymbol{n} = (25536, 9378, 9988)$, $\boldsymbol{m} = (35, 17, 16)$, the estimator (2c) applies, and the fitted model is
$$\hat{n}_1 = 0.80, \quad \hat{n}_2 = 1.00, \quad \hat{o} = 0.0017.$$

Classical Confidence Regions

By definition, confidence intervals for model parameters arise from the distribution of the parameters re-estimated from samples drawn from the fitted model. These distributions can be derived analytically in some cases, but when the model is non-standard, or the estimators are complicated (as here), we may as well just calculate them via simulation.

Using parametric bootstrapping (B=10,000) with the 1999 Stanislaus River data, and applying the routine `sm.density` from the smoothing library of Bowman and Azzalini (1997), ten smoothed density curves were generated for each of the three parameters. These curves are shown in Figure 2, along with the consensus curve obtained by averaging.

The 95% confidence intervals associated with these marginal densities were
$$0.51 \le n_1 \le 1.00, \quad 0.57 \le n_2 \le 1.00, \quad 0.0013 \le \acute{o} \le 0.0026.$$

Problems With Confidence Regions

When the form of the estimator can vary from sample to sample, as in (2a–d) above, the distribution of re-estimated parameters, on which the classical confidence intervals are based, can look very strange. Indeed, this was the case in Figure 2.

The problem here goes beyond aesthetics, however. Because the classical intervals are based on samples from the fitted model, “accidental” features of the basic estimate carry over to these intervals. This is particularly troublesome when, as here, the general behavior of the model is very sensitive to the parameter values. For example, if a basic estimate of survival or capture probability is exactly zero, all the re-estimated values will be also, so that the confidence intervals will have width zero. Although technically correct, such a result is not easy to explain to non-statistical readers, nor particularly useful once explained.

This has been a problem for us in the past and has prompted us to explore other ways of quantifying parameter uncertainty. The only methods which seem applicable here are those which rely on the shape of the likelihood, regarded as a function of the possible states of nature $\mathbf{n}$ when the data $\boldsymbol{m}$ are held fixed.

Marginal Likelihood

The likelihood is a joint function of all three parameters. It is hard to visualize a four-dimensional object such as the graph of this likelihood, or even three-dimensional objects such as its contour surfaces. Ordinarily, we want to consider parameters one or two at a time.

A very simple way to reduce the dimensionality is to consider cross-sections of the likelihood hypersurface along planes (or hyperplanes) perpendicular to the parameter space and passing through the maximum-likelihood estimate. Such cross-sections are shown in Figure 3.

The right way to do things, however, is to integrate out some parameters, and obtain marginal likelihoods on those remaining.

As it turns out, none of the desired integrals can be written in terms of standard functions (or at least in terms of built-in functions of S-Plus). With an eye toward generalization to a greater number of reaches (and consequently higher-dimensional integrals), and the possible introduction of Bayesian methods at some point, we chose to use a form of Monte-Carlo integration. Our algorithm is equivalent to sampling from the joint distribution proportional to the likelihood. The marginal distributions of the components of these samples are then proportional to the marginal likelihoods.

To sample from this joint distribution, consider the change of variables

$$\theta_1 = \mathbf{n}_1\mathbf{n}_2\sigma, \quad \theta_2 = \mathbf{n}_2\sigma, \quad \theta_3 = \sigma.$$

Sampling from the distribution

$$P_{\mathbf{n}} \propto L(\mathbf{n})\,d\mathbf{n},$$

supported on the unit $\mathbf{n}$-cube, is equivalent to sampling from the distribution

$$P_{\boldsymbol{\theta}}^{S} \propto L(\mathbf{n}(\boldsymbol{\theta}))\left|\frac{\partial\mathbf{n}}{\partial\boldsymbol{\theta}}\right|d\boldsymbol{\theta},$$

supported on the simplex $S = \{\boldsymbol{\theta} \mid 0 \le \theta_1 \le \theta_2 \le \theta_3 \le 1\}$.

Interpret $P_{\boldsymbol{\theta}}^{S}$ as the conditional distribution $P_{\boldsymbol{\theta}|S}$, where $P_{\boldsymbol{\theta}}$ is proportional to the extension of $L|\partial\mathbf{n}/\partial\boldsymbol{\theta}|\,d\boldsymbol{\theta}$ to the entire unit $\boldsymbol{\theta}$-cube. Then

$$P_{\boldsymbol{\theta}} \propto \theta_1^{m_1}(1-\theta_1)^{n_1-m_1}d\theta_1 \times \theta_2^{m_2-1}(1-\theta_2)^{n_2-m_2}d\theta_2 \times \theta_3^{m_3-1}(1-\theta_3)^{n_3-m_3}d\theta_3,$$

which is just the product of three independent beta distributions (but notice the subtle effect of the

Jacobian $|\partial \eta / \partial \theta| = \theta_2^{-1} \theta_3^{-1}$ on the parameters of these distributions).

We sample from $P_{\theta|S}$ by simply drawing random samples from P_{θ} and rejecting those which are not in S.

This worked well for the 1999 Stanislaus River data. The marginal likelihood curves shown in Figure 4 were drawn by the method described in Section 2, using a total of 100,000 samples.

Bayesian HPD Regions

The likelihood function is proportional to the Bayesian posterior distribution for the prior consisting of the product of independent uniform distributions on η_1, η_2, and σ. The marginal posterior distributions are simply the normalizations of the marginal likelihoods. This interpretation allows us to use the Bayesian concept of HPD (highest posterior density) regions in place of classical confidence regions.

For the 1999 Stanislaus River data, the marginal posterior distributions are just the normalizations of the marginal likelihoods, presented in Figure 4.

The 95% HPD intervals associated with these were:

$$0.54 \le \eta_1 \le 0.99, \quad 0.58 \le \eta_2 \le 0.99, \quad 0.0014 \le \sigma \le 0.0028$$

Survival in the Lowermost Reach

It is impossible to separate survival in the RM 38–Caswell reach from capture efficiency at the Caswell traps without additional data. If the capture efficiency at Caswell, p, were known, survival in this lowermost reach could be estimated by simply dividing the estimate for σ by p. The confidence and HPD intervals would scale in the same way.

The 1999 Stanislaus River Rotary Screw Trap Program included experiments designed to estimate this efficiency. In these experiments, a total of 4,987 marked smolts were released a short distance upstream of the Caswell traps, of which 103 were subsequently recovered. This yields the efficiency $p = 0.0207$; treating this as if it were an exact value yields an estimate of 0.082 for survival in the RM 38-to-Caswell reach, with 95% confidence and HPD intervals (0.063–0.13) and (0.068–0.14) respectively.

Of course, this value of p is only an estimate, whose uncertainty should be taken into account. This would yield broader intervals for the survival, and shift the survival estimate itself slightly to the right. There are several ways this could be done; the tidiest would be to modify the basic model to have three release locations and four reaches, the last representing the segment between the efficiency release location and the trap, and setting survival in this reach to 1. Alternatively, one could simply treat the recovery of efficiency fish as a separate binomial or Poisson experiment to get estimates the mean and variance of p, use the delta method to approximate the mean and variance of ó $/p$, and inflate the intervals calculated above accordingly.

We do neither of these here, however, because our experience with similar experiments on the Tuolumne River has led us to suspect that conventional trap efficiency experiments like these, in which smolts are released closely enough to the trap that mortality between release and recovery can be safely neglected, may be badly biased as estimators of the efficiency appropriate to groups released much further upstream. We believe that the effect of such bias on the accuracy of the survival estimate are potentially more important than the effect of sampling error on the precision of the estimate.

TASKS 2 AND 3. TRADITIONAL APPROACH

Survival from Knights Ferry to RM 40, Using Data from Oakdale Trap

Survival in the Knights Ferry–RM 40 reach can be estimated using recovery of the Knights Ferry release group at the Oakdale Trap (at RM 40), together with data from the Oakdale Trap efficiency experiments.

Usually, this survival estimate is described as a two-stage process: First, capture efficiency at the trap is estimated as $\hat{p} = m_e/n_e$, where n_e is the number released in the efficiency experiment and m_e is the number of these recovered at the trap. Second, survival from the upstream site is estimated as $\hat{n}_1 = m_s/(\hat{p} \cdot n_s)$, where n_s is the number released in the survival experiment and m_s is the number of these recovered at the trap.

This is equivalent to treating the survival and efficiency releases together as a paired-release experiment (note that this would not be the case if the capture efficiency were estimated separately, e.g., by using the logistic model described in (Demko and Cramer 1998) to predict efficiency from environmental variables). Confidence intervals were constructed on this basis by simulation.

For the Stanislaus River data $n_e = 761,\ m_e = 6,\ n_s = 25{,}536,\ m_s = 156$, the survival estimated in this way is

$$\hat{n}_1 = 0.77$$

with 95% confidence interval

$$0.40 \le n_1 \le 1.00.$$

Survival from Knights Ferry to RM 40, RM 40 to RM 38, and RM 38 to Caswell, and River-Wide Survival, Using Data from Caswell Trap

The same method described above can be used with recoveries of the Knights Ferry, RM 40, and RM 38 release group at the Caswell Trap, together with data from the Caswell Trap efficiency experiments. The efficiency data at Caswell were n_e ' 4,987, m_e ' 103.

Estimates of survivals from Knights Ferry to RM 40 (n_1) and from RM 40 to RM 38 (n_2) can be found as

$\hat{n}_1$ = Survival from Knights Ferry to Caswell / Survival from RM 40 to Caswell,
$\hat{n}_2$ = Survival from RM 40 to Caswell / Survival from RM 38 to Caswell.

These are mathematically equivalent to treating the Knights Ferry and RM 40 releases, and the RM 40 to RM 38 releases, as paired release experiments. However, the point estimates are slightly different, because the constraint n_2#1.00 does not affect other parameters, and the confidence intervals are slightly broader, since these experiments are treated independently here:

$$\hat{n}_1 \text{ ' } 0.77, \quad \hat{n}_2 \text{ ' } 1.00.$$

$$0.44 \# n_1 \# 1.00, \quad 0.55 \# n_2 \# 1.00.$$

Similarly, the confidence interval reported above for survival from RM 38 to Caswell is slightly broader than that found for Task 1, although the estimate itself is identical.

REFERENCES

Bowman, Adrian W. and Adelchi Azzalini. 1997. Applied Smoothing Techniques for Data Analysis. Oxford Statistical Science Series 18. Clarendon Press, Oxford.

Demko, D. B., and S. P. Cramer. 1998. Outmigrant trapping of juvenile salmonids in the lower Stanislaus River, Caswell State Park site 1997. Final report. Submitted to U. S. Fish and Wildlife Service under contract to CH2M Hill. Prepared by S. P. Cramer and Associates, Inc., Gresham, Oregon.

TID/MID (Turlock Irrigation District and Modesto Irrigation District). 1998. 1998 Tuolumne River outmigrant trapping report. Report 98-3 *in* 1998 Lower Tuolumne River annual report. Annual report to the Federal Energy Regulatory Commission (FERC). Prepared by Stillwater Ecosystem, Watershed & Riverine Sciences and Turlock and Modesto Irrigation Districts, with assistance from S. P. Cramer and Associates.

TID/MID (Turlock Irrigation District and Modesto Irrigation District). 1999. 1999 Tuolumne River outmigrant trapping report. Draft. Prepared by Stillwater Ecosystem, Watershed & Riverine Sciences and Turlock and Modesto Irrigation Districts, with assistance from S. P. Cramer and Associates.